APPENDIX D

CLASS II, FILTRATION WITH LITTLE OR NO PRESSURIZATION

D-1. Facility Classification.

New facilities designated to have a Class II CP system do not require a CCA or an airlock for personnel ingress or egress, however, a vestibule that acts as an airlock can be used to maintain overpressure. This class of protection is applicable against a terrorist attack. Vulnerable outside air intakes are protected by a continuous CBR filtration system sized for the normal facility air intake requirements.

D-2. Guidance.

a. *Existing Facilities*. Existing facilities designated to have a Class II CP system will be modified in accordance with this appendix.

b. *New Facilities*. New facilities designated to have a Class II CP overpressure system, or to incorporate design features that ease future installation of a CP system, will incorporate the requirements discussed in this appendix.

D-3. Design Requirements.

Major considerations for the design of Class II CP systems for both existing and new facilities are listed below. Requirements for each item are discussed in subsequent paragraphs.

a. *Toxic-Free Area Envelope*.

b. *Toxic-Free Area Overpressure*.

c. *Toxic-Free Area Envelope Air Leakage Rate*.

d. *Collective Protection System Design*.

e. *Collective Protection Operation and Maintenance Requirements*.

D-4. Toxic-Free Area Envelope.

The total floor area required for the TFA is simply the area requiring collective protection. For Class II facilities, required envelope sealing measures will be minimal. Noticeable leakage paths should be sealed in existing facilities, and sealing measures should be incorporated in the design of new facilities. Though an airlock is not required for this level of protection, a double entry door such as a vestibule entrance can be used to maintain overpressure.

D-5. Toxic-Free Area Overpressure.

For existing facilities being modified or new facilities being designed with a Class II CP system, the air intakes will be protected with a CBR filtration system. The TFA will be designed for a minimum overpressure goal of 5 Pa (0.02 inches wg). This overpressure corresponds to a wind speed impact pressure normal to a wall of 12 km/hr (7 mph). This wind speed condition is most favorable for directing a plume of agent with minimum dispersion toward an outside air intake. After installation of the overpressure system, it is possible that a TFA pressure may be higher than the 5 Pa (0.02 inch wg). A higher pressure provides a higher factor of safety for the CP system and should not be intentionally lowered to maintain a 5 Pa (0.02 inch wg) overpressure.

a. *Existing Facilities*. For existing facilities, the ventilation design will be analyzed to determine if an overpressure can be achieved by supplying additional air through the existing ventilation system, restricting exhaust airflow rates such as from an economizer air exhaust or from other building exhaust systems. The IAQ will still be met since the air is simply exhausted through the TFA envelope. The IAQ and exhaust airflow rates required by building ventilation codes will be maintained. If an overpressure can be achieved with the existing ventilation system, an air leakage measurement test using a blower door assembly will be performed in accordance with ASTM E779. If an overpressure cannot be achieved in existing facilities, good protection is still provided by protecting the outside air intakes.

b. *New Facilities*. For new facilities, overpressure can be achieved by supplying a higher rate of conditioned fresh air to the TFA than is exhausted. To obtain a TFA minimum over-pressure of 5 Pa (0.02 inch wg), the additional air required can be approximated by the unit leakage values presented in Appendix G. In addition, the air leakage calculation procedures in ASHRAE Handbook of Fundamentals can be used to determine the additional air intake requirement.

D-6. Toxic-Free Area Envelope Air Leakage Rate.

a. *Existing Facilities*. For existing facilities, a pressurization test using a blower door assembly will be performed in accordance with ASTM E779. Test data will be plotted on a log-log graph for ease of data tabulation, extrapolation, and review. Air leakage locations can be identified during pressurization testing when the blower door assembly is operated in the negative pressure mode and draws outside air into the proposed TFA. These leakage locations can also be identified by physical inspection or with smoke testing. Leakage areas will be sealed with a good quality sealant or, if necessary, reconstructed. Weather sealing measures can be expected to achieve leakage reductions in the range from 5 to 50 percent depending on the type and quality of facility construction. Sealing of the TFA envelope will reduce the air leakage rate and thus reduce the required amount of filtered air. Sealing measures must be economical when compared to the cost of the filtration and HVAC equipment and, for continuously operated CP facilities, energy usage must also be considered. After sealing, a second blower test will be conducted to determine the final TFA envelope air leakage rate.

b. *New Facilities*. For new facilities, the TFA envelope air leakage rate will be calculated using the effective leakage area procedures in the ASHRAE Handbook of Fundamentals. The leakage calculations will be performed for the TFA envelope including the walls, roofs, floors, doors, windows, sole plates, mechanical and electrical penetrations, ceiling-wall joints, isolation dampers, etc. The overpressure of the TFA will be used as the differential pressure in determining the TFA envelope leakage rate. Appendix G will be used as a guide to confirm the TFA envelope unit leakage rate as determined by the calculations. Care should be taken during design and construction to ensure that proper sealing of penetrations is performed and that continuous air leakage control barriers are used in the TFA envelope. A blower door test of the TFA envelope should be performed after construction to verify the leakage rate and ensure that the CP overpressure filtration system has sufficient capacity.

D-7. Collective Protection System Design.

a. *Airflow Filtration Capacity*. The airflow capacity of the CP overpressure filtration system is the sum of the following two components: TFA envelope air leakage rate at the design pressure differential and the ventilation air intake rate that meets the facility exhaust requirements. The CP filtration system blower total static pressure will be designed to include the filtration system with dirty filters, ductwork system pressure losses, and the overpressure requirement of the TFA. The HVAC system must be designed, operated, and maintained to provide uncontaminated air to the TFA. It will be located in a contamination-free mechanical room to insure that negative pressures induced in the ductwork by HVAC equipment located in the mechanical room will not draw in contaminated air to the protected area. Filtration systems will conform to Appendix E.

b. *HVAC Design Requirements.*

(1) Existing Facilities. For existing facilities, an analysis will be performed to determine if the existing HVAC equipment can be utilized for CP operations to maintain a slight overpressure. If necessary, mechanical equipment modifications will be made to existing facilities and increased equipment capacities provided for new facilities. The HVAC system must be designed, located, operated, and maintained to provide uncontaminated air to the TFA. The outside air intakes will be secured to inhibit the direct insertion of contaminants.

(2) New Facilities. For new facilities, the HVAC equipment will be designed to incorporate the requirements to maintain a slight overpressure and maintain indoor design conditions. The HVAC system must be designed, located, operated, and maintained to provide uncontaminated air to the TFA. The outside air intakes will be located in an inaccessible location or secured to inhibit the direct insertion of contaminants.

(3) Indoor and Outdoor Design Temperatures. Indoor dry and wet bulb design temperatures and outdoor design temperatures will be determined in accordance with TM 5-810-1, associated references, and mission requirements.

(4) Outside Air Occupant Ventilation Rate. The outside air intake rate per occupant will conform to ASHRAE Standard 62 and facility mission requirements.

D-8. Collective Protection Operation and Maintenance Requirements.

a. *Control System Location*. The CP control system will be located in the mechanical room.

b. *CP System Operational Testing*. Periodic CP system monitoring should be performed to ensure it is in good operating condition.

c. *Filter System*. In addition to the manufacturer's recommended maintenance requirements, the filter replacement and testing requirements discussed below should be followed.

(1) HEPA Filter. The initial resistance of the HEPA filter is typically 250 Pa (1.0 inch wg). The HEPA filter should be replaced when it is loaded and the static pressure differential reaches about 750 Pa (3.0 inches wg). The HEPA filter pressure drop will be monitored at the CP system control panel with annunciation when the dirty filter pressure drop is reached.

(2) Adsorption Filter. The adsorber filter should be replaced as required in FM 3-4 and mechanical leak tested with a fluorocarbon refrigerant gas after filter replacement.

(3) Airflow Testing. The filtration system airflow rate should be periodically tested and rebalanced as necessary to maintain the design airflow rate.

(4) Filtration System Testing. The filtration system will be field leak tested by an independent testing agency after installation. The system should also be mechanical leak tested every 12 months and after replacement of the HEPA filter or adsorber filter. The design must ensure that adequate filter access is provided.

e. *Operating Instructions*. Operating instructions will describe, in short and concise language, the steps required to operate the CP system. All CP system control switches and indicators will be clearly marked and identified.

f. *Operation and Maintenance Manual*. An operation and maintenance manual will be provided and will contain system operating instructions, emergency operation instructions, preventive maintenance information, troubleshooting, corrective maintenance, critical instructions, and a spare parts list.